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AN ANALYTICAL STUDY AT THE COLLEGE-ADULT LEVEL

BY

ROBERT A. BROTEMARKLE

A THESIS

PRESENTED TO THE FACULTY OF THE GRADUATE SCHOOL IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

PHILADELPHIA

1924

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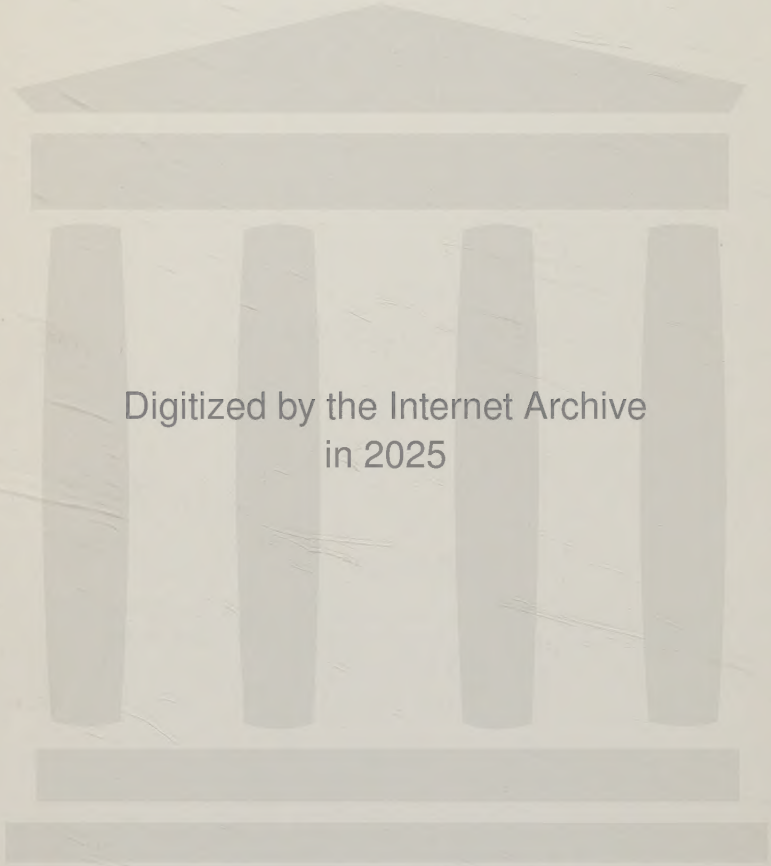
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SOME MEMORY SPAN TEST PROBLEMS

An Analytical Study at the College-Adult Level

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CASES

Those tested were students at the University of Pennsylvania; men and women from the College, School of Education, Wharton School of Finance, Summer School and Graduate School, taking the first year course in psychology during the sessions of 1919-20 and 1920-21. The chronological age level of the group is adult; average 20-21.

Results of Dr. Henry J. Humpstone (3) were gathered from the corresponding classes of previous years and are used in the Standardization of Results.

METHOD

The Memory Span Tests used were given under the "Standard Conditions" as follows:

Experiment No. 1 Memory Span Test for Digits. Group experiment. Selected series; one second interval. Voco-auditory; graphic. Two trials.

Experiment No. 2 Memory Span Test for Three-letter Words. Group experiment. Selected series; one second interval. Voco-auditory; graphic. Two trials.

Experiment No. 3 Memory Span Test for Syllables. Group experiment. Selected sentences. Voco-auditory; graphic. One sentence in each series based on Concrete Visual Imagery, one on Abstract Concepts.

Experiment No. 4 Memory Span Test for Ideas. Group experiment. Paragraph from the Stanford Revision of the Binet-Simon Tests (6), found in year XVIII, Superior Adult, beginning "Tests such as we are now making . . . ." Paragraph read distinctly; five minutes allowed in which to write ideas. Voco-auditory; graphic. One trial.

Experiment No. 5 Memory Span Test for Digits Backward. Group experiment. Selected series; one second interval. Voco-auditory; graphic. Two trials.

Experiment No. 6 Memory Span Test or Digits Forward. Individual experiment. Selected series; one second interval. Voco-auditory; vocal. Two trials.

Experiment No. 7 Memory Span Test for Digits Forward. Individual experiment. Selected series; immediate reading. Visual; vocal. Two trials.

Experiment No. 8 Repeated Memory Span Test for Digits. Given under same conditions as Experiment No. 1 after period of three months.

Experiment No. 9 Introspective Study of Memory Span for Digits. Individual experiment. Selected series; one second interval. Voco-auditory; vocal. Two trials. Graphic record.

RESULTS

The results attained by the original Group Experiments 1, 2, 3, and 4 are the Adult Standards:

Experiment No.	No. of Cases	Maximum	Median	Mode	Mean	Minimum
1—Digits	1263	12	8	8	8.4	4
2—Three-letter Words	1150	8	6	5	5.95	3
3—Syllables	905	50	30	30	31.1	10
4—Ideas	812	12	5	4	4.92	0

	Quintile Rating			
	Digits	Three-letter words	Syllables	Ideas
V	10–12	8	35–50	8–12
IV	9	7	30	6–7
III	8	6	30	4–5
II	7	5	30	2–3
I	4–6	3–4	10-25	0–1

The results derived from Experiments 5, 6, 7, 8 and 9 will be treated in separate sections.

TREATMENT OF RESULTS

"IS THE MEMORY SPAN SCORE ATTAINED BY GROUP TESTING INDICATIVE OF THE ACTUAL MEMORY SPAN OF THE INDIVIDUAL?"

In attempting to ascertain the diagnostic value of the Memory Span of the individual it is not enough to assume that the score

attained under any given method of testing is the actual memory span of the individual. The first problem of memory span testing challenges the accuracy of the memory span score itself.

Is the memory span score attained by an individual in a group testing indicative of the actual memory span?

This question cannot be answered by a comparison of the Original Group score with other Memory Span Test scores; it requires an analysis of the score or response given, and also an analysis of the stimulus which prompts the given response. Is the stimulus well enough organized to elicit the best possible response, not only quantitatively but also qualitatively? Is the response given amply treated by a single quantitative measure or score?

For clearness of definition the stimulus material must provide "discrete elements" of unitary content, otherwise the parts of the stimulus may not be equal in value. The "discrete elements" used in these experiments are digits, three-letter words, integrated syllables in sentence form, and integrated ideas in paragraph form.

In the test for digits, a "serial ordering" whereby a rotation backward or forward, and addition, subtraction, multiplication or division is suggested, must be avoided. In three-letter words, the use of words closely associated in sound or experience must be avoided. In the sentences, the use of confusing words or imagery must be avoided. In the "ideas" test, the entire foundation of communicative language is involved, since a letter, a sound, a word, a phrase, a sentence, a paragraph, a chapter, a book make possible the expression of varying numbers of ideas.

The stimulus material must be presented to exclude variations of sound, breathing and enunciation in the voco-auditory forms of testing, and confusional factors in the visual and kinaesthetic forms. In the case, for instance, of certain colloquial mannerisms of speech, the comparison of original and repeated tests are impossible since the individuals have become accustomed to the original variant factor; nor are they comparable to other tests made under more accurate presentation.

The rate of presentation is more controllable under mechanical means, though the individual rate of discharge of nervous energy adds a variant factor to all vocal stimuli. In the event of a rapid increase in the rate of presentation, when the case is of a low grade of mentality, the individual will often be able to increase his span score for digits by one or two measures. When the rate of presentation falls into the error of rhythmic beats a simple form of grouping of

digits is suggested to the individual, and is seldom escaped in the longer series of digits.

The problems of the response arouse the fundamental questions of the basis of the memory span as an ability. Kirkpatrick (4) discusses the "tendency to repeat what has been perceived," which is but a teleological interpretation of the facts between the presenting of a stimulus and the response to the same. The entire question is expressive of the psychological basis of the fact; a "tendency," a "perceiving," and a "repeating." These require a correlative physical basis, with its so-called "pattern" or nervous set, which will explain in more detail the "impulsive" or "mechanical" basis of imitation, and form a basis for the great psychological development of "volitional" or "reflective" imitation as outlined by Calkins (1). Upon any explanation of the response the elicited response does to some measure reveal the normal memory span of the individual.

During the fall of 1921 the first year class in psychology was given a series of experiments in the memory span test for digits with the results as follows:

MEMORY SPAN TEST FOR DIGITS

	Maximum	Median	Mode	Mean	Minimum
ORIGINAL GROUP TEST..... (Experiment No. 1)	12	8	8	8.18	5
REPETITION OF GROUP TEST..... (Experiment No. 8)	12	9	9	8.9	5
INDIVIDUAL VOCO-AUDITORY TEST.. (Experiment No. 6)	12	8	8	8.07	5
INDIVIDUAL VISUAL-VOCAL TEST... (Experiment No. 7)	13	9	9	8.8	5
GROUP TEST FOR BACKWARD SPAN. (Experiment No. 5)	10	8	8	7.39	4

The repetition of the group test was made three months after the original group test, during which time the class had made a thorough study of the memory span test problems, and had the privilege of increasing their scores by any legitimate means whatever. The individual tests and the group test for the digits backward followed at weekly intervals. No marked increase is noted in the group results. In the four experiments for the digit span forward the group results have an almost constant spread in distribution. In the group test for digits backward a decided spread of distribution below the modal tendency is evidence of the difficulty of the backward span.

The study of the individual variations in these experiments by the group method points to a relatively small increase of the score in

subsequent tests over the original group standing. The variations from the original group standing are as follows:

VARIATION FROM THE ORIGINAL GROUP TEST SCORE

	Repetition of Group Test	Individual Voco-Auditory Test	Individual Visual-Vocal Test	Group Test Digits Backward
Av. Minus Var.	1.51	1.82	1.58	1.85
Av. Plus Var....	1.97	1.27	1.72	1.37
Av. Variation...	1.32	1.09	1.32	1.35
Av. Difference..	+.72	−.16	+.64	−.88

A study of the individual variations by individual methods shows that in a normal group of college adults the extreme variations of the original group tests for memory span for digits forward will be largely reduced by subsequent tests to a central or modal tendency of 8-9-10, as the modes of the memory span for digits for adults,—the 8 being a modal tendency indicative of a low memory span; the 9 being a modal tendency indicative of a median memory span; and the 10 being a modal tendency indicative of the high memory span. The fact already noted, that the normal variations of the individual span score is from 0 to plus or minus 3, further corroborates these modal points since the usual variations will not displace the original standing of low or high scores,—there being but a single variation of 5 in the low group; eight variations of 4 in the low, ten of 4 in the high, and three of 4 in the median.

In the case of the backward span for digits it will be noted that the tendency of the lower score is to vary but not by more than ± 2, there being but one variation of ± 3; the median scores varying by ± 2, with the exception of two cases at $+3$; the high scores varying to great extremes, however, there being one variation of -6, two of ± 5, four of ± 4, nine of ± 3.

A study of the two experiments in individual tests will further corroborate the indicative value of the memory span score attained by any test under standard conditions. The average variation of the visual-vocal method over the vocal-auditory being +.76, indicating a standing of about 1 measure higher in the visual tests over the vocal; whereas the actual variations do not displace the original standing of the results.

IS THE MEMORY SPAN DIAGNOSTIC OF SPECIFIC ABILITIES OR DEFECTS?

Of what mental ability is the memory span diagnostic? Is it diagnostic of some specific mental ability or defect; and if so, how

much are these abilities involved in the definition of memory span? The Table of Distribution for experiments 1, 2, 3, and 4 enable us to settle upon the cases for immediate study, there being a definite curve with the extremes well defined. It is in the extreme low and high scores that we find the actual case problems involved, and for that reason—arrived at by laboratory and clinical experience—the following scores are arbitrarily used to decide the cases for study.

LOW MEMORY SPAN SCORES

	Measure	Per cent of Cases
Digits	4–5	3.1
Three-Letter Words	3–4	8.4
Syllables	10–20	4.41
Ideas	0–1	7.42

HIGH MEMORY SPAN SCORES

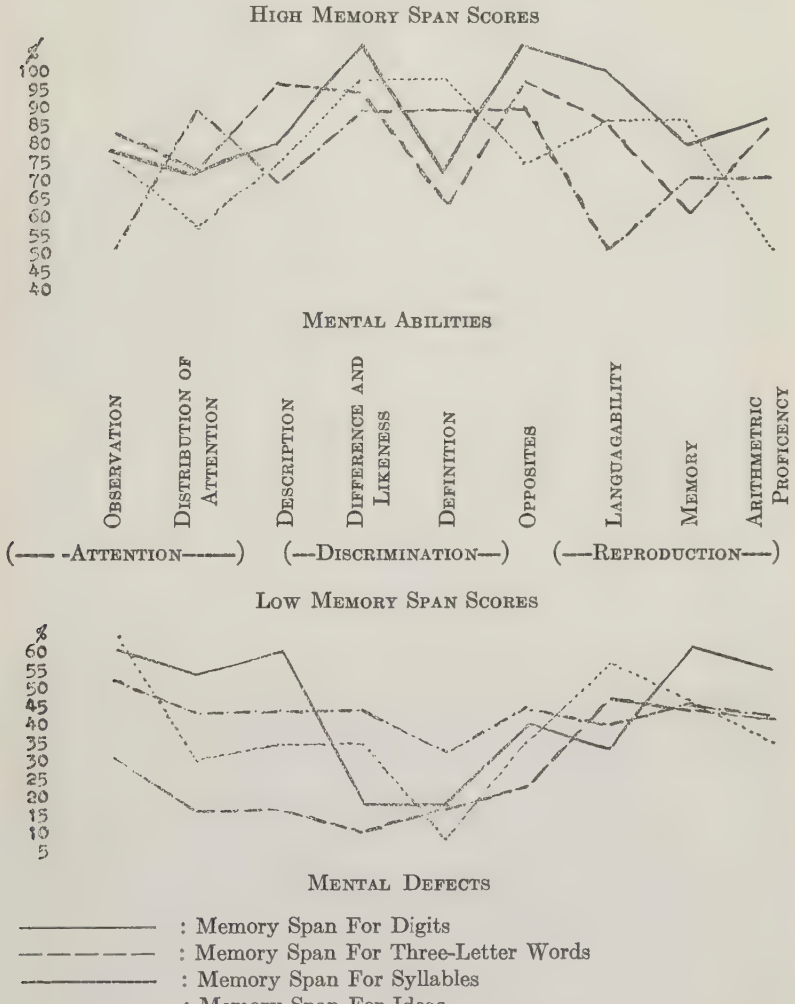
Digits	12	4.3
Three-Letter Words	8	11.4
Syllables	40–50	3.2
Ideas	9–12	7.74

The quintiles already noted in the standards for memory span scores for college adults are to a large degree indicated by these scores, the first (I) and fifth (V) quintiles of each group being to a large measure used for this study.

In a recent study of *The Competency of Fifty College Students*, Miller (5) reports a series of mental abilities tests made during the same period of laboratory instruction with the same group. These tests have been sufficiently well standardized for us to note the mental ability or defect involved in each test. The following graphs will show the percentage of cases in which the various abilities or defects are of the same high or low standing as each of the four types of memory span scores. The abilities are correlated to the high span scores; the defects are correlated to the low memory span scores.

In the case of the high memory span scores the correlation of the mental abilities varies between 100 percent and 45.46 percent with an average of 76.3 percent. In the case of the low memory span scores the correlation of the mental defects varies between 61.9 percent and 11.21 percent with an average of 36.05 percent. The memory span score is not of consistent diagnostic value for any of the specific mental abilities or defects. However, a very definite tendency is discernible in the fact that the scores are more diagnostic of certain groups of mental abilities or defects than others. In the case of the attention factors—observation, distribution of attention,

description—and the reproduction factors—languagability, memory, arithmetical proficiency—a more decided tendency of diagnostic value is noted than in the discrimination factors.



Definition of Memory Span

Memory span then is not diagnostic of certain mental abilities or defects but is an ability itself which involves the attentional field in an act of immediate reproduction; it is a mental grasp and nothing more. The grasp is a specific mental ability, limited by its

employment of other defective abilities, but not primarily dependent upon them.

Humpstone (2) has given us a clear definition of memory span, involving the stimulus, mental process and response: "Memory span is the ability to grasp a number of discrete elements in a given moment of attention and reproduce the same immediately." The stimulus and response have been noted; it is the mental process with which we are here concerned.

A mental process involving the field of attention in a spatial existence of successive events is not easily analyzed, and yet it is of sufficient complexity to involve any and all of the factors of the attentional abilities. The analytical concentration of attention, the persistent concentration of attention, its distribution, and its "motivated" factors of alertness and interest may readily play their independent or component part in the "given moment."

And again, though memory span is not memory, as shown by Humpstone (2), it not only makes use of the attentional field in the first instance, but of the various imagery fields and various types and laws of association, at the same time relying upon its own grasping power to secure the material for immediate reproduction.

IS THE MEMORY SPAN DIAGNOSTIC OF THE COMPLEXITY OF MENTAL ORGANIZATION?

The memory span is of diagnostic value not alone because of its own *simplicity*, but also because of its use of the numerous mental factors of the attentional, imagal and associational fields—its use of mental complexity.

While no test will give us a rating of the general mental organization of the individual, this intellectual standing may be readily subsumed under the general grades of the college courses. The various factors of marking and grading are not to be considered constant, even in the individual—much less in the group—yet in the summation of grades much of the variance will be smoothed out. The grading system used at the University of Pennsylvania is a rough quintile system using the letter D for the upper of V quintile, G for IV, P for III, N for II, and F for I.

Two summation grades have been chosen for comparison with the memory span scores or standing. First, the psychology grade attained in the first year course, which is the combined judgment of from four to seven instructors and professors, who have had the

opportunity to analyze the individual's work from various angles; and second, the college grade which is the combined standing of the individual in all of the courses taken to date, and is the summation judgment of numerous teachers.

In the case of the psychology grades the accuracy of the diagnosis by low memory span scores ranges from 67-93 per cent, or from a ratio of 2-1 to a ratio of 13-1; by the high memory span scores the accuracy ranges from 53-64 per cent, or from a ratio of 1-1 to a ratio of 2-1. The low memory span scores having a ratio of 5.5-1, the high-memory span scores having a ratio of 1.75-1 on the average. In the case of the college grades the low memory span scores have a range of 44-75 per cent, or from a ratio of 1-1 to a ratio of 3-1; the high memory span scores have a range from 78-90 per cent, or from a ratio of 3-1 to a ratio of 9-1. The low memory span scores have a ratio of 1.5-1, and the high memory span scores have a ratio of 6.5-1 on the average.

The Individual Cases

While much may be adduced from the group results, the real diagnostic value of the memory span is to be found in the individual study of case problems. Of the cases indicated as of high or low standing by the memory span scores a limited number of cases were complete in material and data for individual treatment, and these are presented as follows: In the low digit span scores are included all the cases with a low digit span score, and also inclusive of all those low in either the three-letter word, syllable, or idea spans; in the low three-letter word span scores are included all those having low three-letter word spans not already included under the former group, and also those having low syllable or idea spans with three-letter spans. The same ordering is followed under the titles of low syllable spans, low idea spans, high idea spans, high syllable spans, high three-letter word spans, and high digit spans. The sex is noted by letter F for female, M for male. The cases are numbered, and quintile ratings given in the summation scores for mental abilities, mental complexities, and trainability as taken from the various laboratory records, while the college grardes are noted as high for a standing of 5.5-4, medium for 3.9-3.5, and low for 3.4 down the quintile scale.

In the individual case the number in italics indicates that the span score supports the diagnosis of the original score whether high or low. In the low span scores the number in bold face indicates that the score does not support the original score.

The following ratio of diagnostic value is found: The low digit span has a diagnostic accuracy of 7-1; the low three-letter word span 4-1; the low syllable span 24-1; the low ideas span 13-1; the high digit span 2.6-1; the high three-letter word span 3.1-1; the high syllable span 2-1; the high ideas span 3.1-1. The low span scores have an average diagnostic accuracy of 12-1; the high span scores an average of 2.25-1.

The low memory span is far more pronounced in its diagnostic accuracy than the high memory span. This is true even where an attempt made to explain many of the "Not Diagnostic" cases, since most of the explanations possible will be in favor of the low memory spans. For example cases 14, 15 and 36 have a "limited span" with a high degree of trainability and are thus able to make a greater use of the fundamental abilities at hand. Other cases, as for example, cases 34 and 92, may be found to be weighted more accurately by other scores than those under which they have been originally listed.

Low Digit Span Cases

Sex	Case Number	Abilities	Complexes	Trainability	College Standing	Spans			Remarks
						3-letter word	Syllable	Ideas	
F	1	1	2	3	Low	*4*	30	6	Three-letter word span low.
M	2	1	1	4	Low	*3*	*20*	5	Three-letter word span low. Syllable span low.
M	3	1	1	2	Low	7	25	4	Committee Dropped from College.
F	4	1	2	1	Low	*4*	25	5	Three-letter word span low.
M	5	2	3	1	Low	*3*	30	3	Three-letter word span low. (Repeated course in Summer School with same scores in all spans.)
F	6	1	3	2	Low	5	25	2	
M	7	2	3	5	Low	5	25	4	Attention defects.
F	8	1	3	2	Low	8	30	6	Observation and Attention defects.
F	9	2	2	1	Low	6	30	?	Imagability and Definition defects.
F	10	3	4−	1	Low	7	30	4	Trainability defect.
M	11	3−	3−	3	Low	6	35	4	Observation defect. Motivation defect: Lazy.
F	12	2	3	2	High	5	35	8	Description defect. Psychology, grades, N. P. Question college grades.

LOW DIGIT SPAN CASES—*Continued*

SEX	CASE NUMBER	ABILITIES	COMPLEXES	TRAINABILITY	COLLEGE STANDING	SPANS			REMARKS
						3-letter word	Syllable	Ideas	
F	13	2	3	1	High	5	30	6	Drudge. Question grades. Takes courses in Summer School gradually.
F	14	3	3	5	High	*4*	30	*1*	Three-letter word span low. Ideas span low. NOT DIAGNOSTIC. "Limited span" without grouping.
F	15	2–	2	2	High	*4*	30	5	Three-letter word span low. Abilities defects-General. Question college grades.
F	16	1	3	5	High	5	35	8	NOT DIAGNOSTIC. "Limited span" without grouping.

LOW THREE-LETTER WORD SPAN CASES

SEX	CASE NUMBER	ABILITIES	COMPLEXES	TRAINABILITY	COLLEGE STANDING	SPANS			REMARKS
						Digit	Syllable	Ideas	
M	17	2	3	1	Low	3	*20*	*1*	Ideas span low. Syllable span low.
M	18	3	4	5	Low	6	25	8	Motivation defect.
M	19	2	3–	4	Low	8	30	6	COMMITTEE DROPPED FROM COLLEGE.
M	20	2	3	1	Low	6	30	3	Trainability defect.
M	21	1	3	4	Low	8	30	2	Cramped abilities. Description low.
F	22	2	3	1	Low	7	30	7	Trainability defect. Dropped from college.
M	23	3–	3–	5	Low	?	30	2	Abilities high. Complexities low. Drudge type.
F	24	1	3	5	Low	8	25	5	Cramped abilities. Trainability plus.
M	25	4–	3	5	Low	7	25	4	Description low. Use of abilities low.
F	26	1	3–	2	Low	6	30	3	Cramped abilities. Trainability low.

LOW THREE-LETTER WORD SPAN CASES—*Continued*

SEX	CASE NUMBER	ABILITIES	COMPLEXES	TRAINABILITY	COLLEGE STANDING	SPANS			REMARKS
						Digit	Syllable	Ideas	
M	27	3–	4	1	Low	6	35	6	Observation and Discrimination defects.
M	28	2	2	2	Low	7	30	4	Consistent defects.
M	29	3–	3	3	Low	7	30	6	Consistent defects.
M	30	2	2	1	Low	11	35	*0*	COMMITTEE DROPPED FROM COLLEGE. Idea span low.
M	31	3–	3	4	Low	6	*20*	*1*	Syllable span low. Ideas span low.
F	32	1	1	2	Low	10	*10*	*1*	COMMITTEE DROPPED FROM COLLEGE. Syllable span low. Ideas span low. (Repeated tests second year with same scores.)
F	33	3	3–	5	High	6	30	*1*	Idea span low. Languagability defect. Drudge type.
M	34	3–	3	5	High	9	30	10	NOT DIAGNOSTIC.
M	35	3	4	5	High	9	30	*4*	NOT DIAGNOSTIC.
F	36	2	3–	5	High	7	25	5	Question college grades.
M	37	2–	3	1	High	9	30	8	NOT DIAGNOSTIC. Motivation: Lazy.
F	38	3–	3	3	High	6	30	7	NOT DIAGNOSTIC.
M	39	3–	4	2	High	7	30	5	NOT DIAGNOSTIC.
F	40	3	3	4	High	8	30	5	NOT DIAGNOSTIC.
F	41	3–	4–	4	Medium	6	30	*1*	Idea span low. Trainability plus.
M	42	4	3–	1	Medium	12	35	4	Languagability defect.
F	43	2	3–	2	Medium	7	25	7	Trainability defect.
M	44	2	4–	4	Medium	9	30	5	Abilities defect.
F	45	3	3	1	Medium	6	30	6	Trainability defect.
M	46	2	3–	4	Medium	8	25	5	Abilities defect.
F	47	2	3	3	Medium	7	25	8	Abilities defect.
M	48	3	3–	3	Medium	11	30	6	Motivation defect: Lazy.
M	49	2	4–	3	Medium	8	35	8	Drudge. Summer School case: courses taken over period of years.
M	50	4–	?	4	?	11	35	4	Dropped from college before grades given: Excluded from 5 courses.

LOW SYLLABLE SPAN CASES

SEX	CASE NUMBER	ABILITIES	COMPLEXES	TRAINABILITY	COLLEGE STANDING	SPANS			REMARKS
						Digit	3-letter word	Ideas	
F	51	3–	3	1	Low	10	5	*0*	Ideas span low. Description low.
M	52	2–	1	?	Low	8	5	*1*	Ideas span low. Persistence defect. Probation at time.
M	53	2–	3–	5	Low	10	5	*1*	Ideas span low.
M	54	1	2	1	Low	9	5	*0*	Ideas span low.
M	55	2	4–	5	Low	8	?	2	Abilities defect.
M	56	2	3–	1	Low	8	8	3	COMMITTEE DROPPED FROM COLLEGE. Abilities and Trainability defects.
F	57	3–	3–	1	Low	11	7	?	Abilities and Trainability defects.
M	58	2	2	2	Low	7	5	2	COMMITTEE DROPPED FROM COLLEGE.
F	59	3–	3	5	Low	8	6	3	Abilities defect: Attention and Imagation.
M	60	3–	3–	5	Low	6	6	2	Abilities defect: Attention and imagation.
M	61	2–	3–	5	Low	8	6	3	Abilities defect: Attention and imagation.
M	62	3–	2	1	Low	7	5	2	Abilities defect: Attention, imagation and discrimination.
M	63	3–	3	?	Low	7	6	6	COMMITTEE DROPPED FROM COLLEGE.
M	64	3–	3–	5	Low	6	5	7	Abilities defect: Observation and languagability.
M	65	2–	2	4	Low	8	4	6	Abilities defect: Attention, imagation, and discrimination.
M	66	2	3	2	Low	8	5	5	Abilities defect: Attention and imagation.
M	67	3–	3	3	High	8	6	8	Question grades. Withdrew from psychology second term.
M	68	3–	3	5	High	7	7	3	Question grades. Withdrew from psychology second term.
M	69	2–	2	5	High	7	5	6	NOT DIAGNOSTIC.
F	70	2	3	3	Medium	6	5	?	Question high grades.
M	71	2–	2–	1	Medium	10	5	*0*	Ideas span low. Personality defect: Babyish and unpleasant.

LOW IDEAS SPAN CASES

SEX	CASE NUMBER	ABILITIES	COMPLEXES	TRAINABILITY	COLLEGE STANDING	SPANS			REMARKS
						Digit	3-letter word	Syllable	
F	72	1	2−	1	Low	7	5	30	Abilities defect.
M	73	2	3−	?	Low	9	7	30	
M	74	2−	1	1	Low	?	?	?	Abilities defect: Attention.
F	75	3−	2	2	Low	9	7	30	Abilities defect: Attention and Imagation.
M	76	2	2−	4	Low	6	5	30	Abilities defect: Attention, observation and imagation.
M	77	4	4	5	Low	11	8	30	
F	78	3−	3	4	Low	7	5	30	Observation low.
M	79	3−	3	2	Low	7	5	30	Trainability defect.
M	80	1	1	1	Low	7	6	30	Abilities defect: General—.
M	81	3−	3	4	Low	6	6	30	Observation low.
M	82	2	3−	?	Low	6	5	30	Abilities defect: Attention, imagation and discrimination.
F	83	2	3−	2	Low	7	6	35	Observation low.
M	84	3	3	4	Low	8	6	25	Languagability defect. Dropped from college.
M	85	2−	2−	1	Low	11	7	25	COMMITTEE DROPPED FROM COLLEGE.
M	86	3	3	3	Low	8	7	30	
F	87	2	2	1	Low	12	8	30	Abilities defect.
M	88	?	?	?	Low	6	7	25	COMMITTEE DROPPED FROM COLLEGE.
M	69	1	3	1	Low	10	6	35	COMMITTEE DROPPED FROM COLLEGE.
F	90	3−	3	3	High	8	6	30	Observation low. Question high grades.
M	91	3−	3	5	High	8	5	30	NOT DIAGNOSTIC.
F	92	3	4	4	High	12	8	30	NOT DIAGNOSTIC.
F	93	3−	2	3	Medium	8	7	30	
F	94	2	3	5	Medium	8	5	30	Trainability defect. Observation defect.
M	95	3−	4−	2	Medium	8	7	30	Trainability defect.
M	96	3	4−	?	Medium	11	7	30	Description low.
M	97	2−	3	1	Medium	7	5	25	Abilities defect: Observation, attention, imagation and discrimination.
M	98	2	2	?	Medium	7	5	30	Abilities defect: Imagation and discrimination.
M	99	2	3−	3	Medium	?	5	30	Imagation low.
F	100	2−	1	1	Medium	8	8	30	Abilities defect: General—.

HIGH IDEAS SPAN CASES

Sex	Case Number	Abilities	Complexes	Trainability	College Standing	Spans			Remarks
						Digit	3-letter word	Syllable	
F	101	2	3–	4	High	9	7	30	Trainability plus.
F	102	4–	4	?	High	9	*8*	30	Observation low.
M	103	4	3	3	High	10	7	30	
M	104	3	4–	3	Medium	10	5	35	
M	105	2	3–	2	Medium	?	?	?	Abilities defect: Discrimination and definition. Question high grades. NOT DIAGNOSTIC.
M	106	4–	3	3		7	6	30	
	107	2–	3	1	Medium	9	6	30	Abilities defect: Attention, imagation, observation. NOT DIAGNOSTIC.
M	108	3	4—	5	Low	9	6	30	Languagability defect. NOT DIAGNOSTIC.
F	109	4	4	1	High	9	5	*40*	Attention low.
F	110	4	4	2	High	10	*8*	*40*	Trainability low.
F	111	2	3—	5	Medium	*12*	*8*	35	Abilities defect.

HIGH SYLLABLE SPAN CASES

Sex	Case Number	Abilities	Complexes	Trainability	College Standing	Spans			Remarks
						Digit	3-letter word	Ideas	
M	112	4–	4	1	High	10	7	3	Distribution of Attention low.
F	113	3–	3	2	High	8	6	5	Distribution of Attention low.
F	114	4	4	3	High	7	7	5	Distribution of Attention low.
M	115	4	3–	4	High	10	*8*	7	Languagability low.
M	116	4	4–	3	Medium	10	5	5	
F	117	3–	3	2	Medium	?	?	6	NOT DIAGNOSTIC.
F	118	3–	3	1	Medium	7	7	?	NOT DIAGNOSTIC.
F	119	2	3	3	Medium	10	*8*	5	Abilities defect: Attention, observation, and languagability.
F	120	2–	2	2	Medium	10	6	2	NOT DIAGNOSTIC.
M	121	2	3–	2	Medium	8	7	2	NOT DIAGNOSTIC.
M	122	3	3	4	Medium	8	*8*	6	
M	123	2	3–	?	Low	8	6	2	NOT DIAGNOSTIC.

HIGH 3-LETTER WORD SPAN CASES

SEX	CASE NUMBER	ABILITIES	COMPLEXES	TRAINABILITY	COLLEGE STANDING	SPANS			REMARKS
						Digit	Syllable	Ideas	
F	124	3	4–	1	High	*12*	35	7	Trainability defect. Attention defect.
M	125	4–	3	3	High	*12*	30	7	
M	126	4	4	4	High	*12*	30	4	
M	127	3–	4–	5	High	9	30	7	Attention and Observation low.
F	128	3	3	3	High	9	30	6	Memory defect.
M	129	3–	3	2	High	9	30	5	Trainability low.
F	130	5–	4	5	High	9	30	?	Attention plus. Languagability low.
M	131	3–	3	4	High	9	30	8	Left college.
F	132	2–	3–	1	High	9	30	4	Attention, memory and definition low.
F	133	3–	3	4	High	8	30	7	Attention and definition low.
F	134	2	3–	4	High	10	30	2	Memory and definition low.
M	135	4–	4	3	High	8	35	6	
F	136	3	3	3	High	10	30	5	
F	137	4–	3	3	High	9	35	8	Definition and languagability low.
M	138	3–	3	5	High	9	30	8	Memory low.
F	139	3–	3	?	High	8	30	3	Observation defect.
M	140	3–	3	5	High	11	30	7	Discrimination, definition and memory defect.
M	141	4	4–	1	High	8	35	8	Trainability defect.
F	142	4–	4	4	High	10	30	4	Languagability defect.
F	143	3–	3	2	Medium	9	30	?	Attention and memory defect.
M	144	3	3	3	Medium	8	30	8	Left college.
M	145	3–	3	5	Medium	10	30	6	Observation low. Definition low.
F	146	3	3	5	Medium	10	30	3	Observation and attention low.
F	147	2	3–	2	Medium	11	35	2	Abilities defect: General—. NOT DIAGNOSTIC.
F	148	3	4	3	Medium	8	30	8	
F	149	2	3–	4	Medium	9	30	7	Abilities defect: General—. NOT DIAGNOSTIC.
F	150	2–	2	1	Medium	9	30	3	Definition and memory low.
M	151	3	3	5	Medium	11	30	4	Observation low.
F	152	3	4–	4	Medium	10	30	7	
M	153	2	2	1	Low	9	30	4	COMMITTEE DROPPED FROM COLLEGE. NOT DIAGNOSTIC.

Sex	Case Number	Abilities	Complexes	Trainability	College Standing	Spans			Remarks
						Digit	Syllable	Ideas	
M	154	2–	?	?	Low	9	30	4	Committee Dropped from College. Not Diagnostic.
M	155	2	2	2	Low	10	30	3	Committee Dropped from College. Not Diagnostic.
M	156	2	2	4	Low	8	30	2	Committee Dropped from College. Not Diagnostic.
M	157	2	2	1	Low	9	30	4	Committee Dropped from College. Not Diagnostic.
M	158	3	4–	5	Low	6	30	5	Attention and memory low.

High Digit Span Cases

Sex	Case Number	Abilities	Complexes	Trainability	College Standing	Spans			Remarks
						3-letter word	Syllable	Ideas	
M	159	3–	3	3	High	6	35	5	Abilities defect: Attention and observation.
F	160	4–	3	1	High	7	35	6	Trainability defect.
M	161	4	4	5	High	7	30	8	
M	162	3	4–	4	High	6	35	5	
M	163	3	4–	5	High	7	30	6	Languagability low.
M	164	4	4	1	High	7	30	8	Attention low.
M	165	3	?	?	High	7	30	5	Left college.
M	166	4–	3	4	Medium	5	30	7	Definition low.
M	167	2	3–	5	Low	7	30	4	Abilities defect: Observation, attention, and memory.
M	168	3–	3	5	Low	5	35	?	Abilities defects: General—. Not Diagnostic.
F	169	3–	3–	5	Low	6	30	4	Observation and attention defects. Not Diagnostic.

As in the group study we again find far greater ratios of accuracy for certain types of spans. In the case of psychology grades and college grades alike, the syllable span and the ideas span stand far above the digit span and the three-letter word span. This accuracy is most pronounced in the low span cases. The relative diagnostic value of the spans for college levels is roughly from highest to lowest: syllable span, ideas span, digit span and three-letter word span.

It is apparent that some variance may be found when we are considering different types of memory span scores in relation to mental organization, though the memory span may on the whole be considered diagnostic of mental complexity.

IS THE MEMORY SPAN CONSTANT IN THE USE OF MENTAL COMPLEXITY IN THE INDIVIDUAL?

This question suggested by the variant factors already noted is answered by an introspective study of the memory span process. The following study was made by fourteen individuals with the staff of the Psychology Department and Graduate School at Clark University.

INTROSPECTIVE STUDY OF THE MEMORY SPAN

Directions: I am going to present to you several series of digits of varying length, each preceded by a "ready" signal.

During the presentation you will listen merely to the digits as read. Immediately after the presentation you will verbally reproduce the series or as much of the series as possible.

Immediately following your reproduction of the series you will give an introspective account of the content of consciousness from the "ready" signal to the end of your reproduction.

	First Trial	Second Trial
Series.....	5316	4715
.....	69517382	58149372

Time between the first and second trials: 3 days.

Results

Key:

A —Auditory Imagery.
V —Visual Imagery.
Vm —Voci-motor Imagery.

The order of mention, importance and combination is given preference, when the letters are separated by a dash the imagery was stated as separated; when no dash appears it was mentioned as combined.

The words quoted are condensed from the report, but are the words of the individual himself.

Four Digits	Eight Digits
Case No. 1	
First Trial	
A-V "simply initiated the reproduction."	A-V "tried to say it fast, lest I should forget before I was done."
Second Trial	
A-V "last number immediately set off the vocimotor reproduction."	AV-Vm "Immediately I began the reproduction. The V of the last four numbers was very obscure by now, but it revived as I was saying them off."
No. 2	
First Trial	
V-Vm	V-A-Vm "rather confused combinations," "unpleasantness."
Second Trial	
V "visual schemati." "inhibition of breathing."	V-A "blurred and confused." "increase in intensity and extensity of organics, great unpleasantness."
No. 3	
First Trial	
V-Vm	V-Vm "unpleasant feeling."
Second Trial	
V-Vm "feeling of certainty."	V-A-Vm "distinct organics."
No. 4	
First Trial	
Vm-V "easier than copying them."	A "not time to repeat each to myself." "seem to come in proper order, I hardly knowing it was right order until I heard my own voice."
Second Trial	
V-Vm "general attentive bodily set."	Vm-V-A "first three numbers I was very sure of—and last two—the middle ones were less certain."
No. 5	
First Trial	
A-Vm "successive A images."	A-Vm "grouped first four, first four and next two, then first four and next two and last two digits." "practically no kinaesthetics."

SECOND TRIAL

Vm-A "expectancy." "slight electric currents—palms of hands and wrists."	Vm-A "little tension of expectancy—but much greater expectancy of effort." "kinaesthetics—eyebrows, forehead, ears and scalp." "kinaesthetic movements in blood vessels in neck very distinct." "grouped as in first trial."

No. 6

FIRST TRIAL

V "distraction—what to expect—how to write introspection." "speculative attitude until digits begin."	V "difficult to visualize all the numbers." "affective attitude—due to lectures on introspection."

SECOND TRIAL

V-Vm "feeling of sureness."	V-Vm-A "kinaesthetic feeling of crouched attention (muscularly alert)."

No. 7

FIRST TRIAL

A "muscular relaxation." "no tension." "listened passively and repeated automatically."	A-Vm "mixed up at end of first five digits—got last three passively—letting them sink in."

SECOND TRIAL

Vm "no organics." "relaxation of tension." "nothing in consciousness but numbers—till repeating them in same tempo."	Vm "strong tension in fingers." "eyes tightly closed." "straining of ears." Hopelessly confused—trying to repeat entire series each time new number given." "Consciousness of thought: 'if only I had grouped them.'"

No. 8

FIRST TRIAL

Vm "tension of mind." "absorbed in introspection."	Vm "introspection." "grouped hastily." "doubtful of accuracy."

SECOND TRIAL

Vm "mental tension and expectancy." "repeat and group."	Vm "More distraction (sources unknown)." "attention on getting rid of series before they were lost."

No. 9

FIRST TRIAL

V-Vm "general kinaesthetics—viscera, ears, neck." "V images danced before eyes." "eyes open—unaware of surroundings."	A-V-Vm "grouping," "kinaesthetics in viscera—stomach and esophagus, warm waves upward."

SECOND TRIAL

V-Vm "kinaesthetics (as before)." "visual schemati—yellow spots with black periphery."	A-Vm-V "kinaesthetics (as before) plus swaying of body." "rhythm." "grouped."

No. 10

First Trial

Vm "tension-tightening of system—joints left to wiggle rapidly." "throat kinaesthetics." "reproduction simply a repetition of the Vm experience."

Vm-A "kinaesthetics—quivering." "visual blankness." "Vm experience—'I've done this before.'" "frantic repetition." "internal speech series."

Second Trial

Vm "fore-period kinaesthetics." "numbers snatched into Vm field." "rapid repetitions." "organics." "throbbings."

Vm "fore-period (as before) with dull pressure between the eyes." "kinaesthetics—more active." "organics—general and breathing." "throat center or rapid repetitions."

No. 11

First Trial

A-V-Vm "auditory preceptions satisfying." "focal striving of preparation: organic and kinaesthetics (vague)."

A-V-Vm "kinaesthetics and organics—unpleasant but indescribable." "forced types of images by repetition and reproduction." "visual schemati."

Second Trial

A-V-Vm "very confused." "fear of distraction."

A-V-Vm "(as above) head bent forward." "perception seemed satisfactory." "assurance that correct."

No. 12

First Trial

Vm "narrowing of field of attention." "strain." "sureness and adequateness of response."

Vm "kinaesthetics in chest—strain." "confusion—unable to put in order." "feeling of inadequateness of representation."

Second Trial

Vm "kinaesthetics—chest; pressure in stomach." "reproduction quick and sure."

Vm "body set—kinaesthetics (as before)." "after first four numbers, recall them in memory and continue listening." "repeated quickly for fear of losing them or order." "sureness but not absolute confidence."

No. 13

First Trial

Vm "repeated after examiner and muscular contraction in throat and back of head."

Vm "passively fix each number in mind." "not conscious of movement until brought to light in introspection."

Second Trial

A "seemed to simply comprehend it." "tense feeling of strain."

Vm-A "attempted to take passively—easier." "movement of rapid review."

No. 14

First Trial

(?) "muscles set—not strain." (A) "feeling of tenseness." "fear-not being able to remember." "not comprehending."

A "strained attitude at first." "relaxation to tenseness." "feeling of obscurity; assisted by a rhythmic feeling."

Second Trial

(?) "relaxation." "feeling of surprise at (A) not being more digits."

A "feeling of anxiety." "saying over mentally." "no special tenseness of muscles." "doubtful whether one can give auditory attention without something of muscular tension particularly in neck muscles." "slight inhibition of breathing."

TREATMENT OF RESULT

I

Types of Imagery Used

Number of times

	Four digits	Eight digits
A	4	3
V	2	1
Vm	8	7
A-V	2	2
A-Vm	2	5
V-Vm	8	1
A-V-Vm	2	9

II

Variations in Types of Imagery Used

From Four to Eight Series

	No. of Times	No. of Cases
Vm added	3	3
A added	9	6
A-V-Vm emphasis changed	1	1
Vm emphasis same	4	2
A emphasis same	2	1
A-V-Vm emphasis same	2	1

III

Variations in Concomitants

From Four to Eight Series

	No. of Times	No. of Cases
Uncertainty, Obscurity, etc.	15	8
Unpleasantness	4	3
Organics	3	3
Kinaesthetics	13	8
"Affective attitude"	1	1
Grouped	5	3
Rhythm	2	2

A complexity of imagery is found in 10 of the 14 cases, usually typified by the addition of auditory imagery; a complexity of some concomitant is found in all 14 cases, usually typified by the addition of uncertainty, obscurity and kinaesthetics. Peculiarly enough the vocimotor imagery usually calls for kinaesthetics and organics, while the auditory imagery usually calls for greater uncertainty.

It is clear that the spans of varying length call for entirely different backgrounds of mental complexity, that the same span is not constant in the use of the mental complexity of the individual, that the same span does not call for the same mental complexity in different individuals, and that therefore the memory span is not constant in any way in its use of the mental complexity.

SUMMARY OF EXPERIMENTS AND CONCLUSIONS

1) The diagnostic value of the memory span test is readily evidenced in the manner in which it clearly differentiates the two extreme groups, the upper and the lower.

2) The memory span test is diagnostic of the complexity of mental organization taken as a bodily factor including the competencies with which the individual makes for successful performance.

3) The memory span test is of little value except it be used by the examiner who has concisely arranged the stimulus with the intention of removing all the inherent "dangers" from the span itself and from the manner of its presentation.

4) The memory span score is not sufficient in itself; it requires a complete analysis of the complexity of the mental processes involved, and assurance of the directness of the response.

5) The memory span has a certain restriction placed upon its use by the intellectual level of the individual being tested. This is clearly noted in the varying diagnostic values of the different types of memory span. Further research in this field should reveal the relative diagnostic use of the different types of memory span tests at varying intellectual and age levels.

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COMPLETE SET OF TABLES FOR MEMORY SPAN TEST PROBLEMS—AN ANALYTICAL STUDY

DISTRIBUTION OF MEMORY SPAN FOR DIGITS FORWARD

Measure	No. of Cases	Percentage
4	3	.2
5	37	2.9
6	113	8.9
7	237	18.7
8	292	23.1
9	272	21.5
10	162	12.8
11	92	7.3
12	55	4.3
Total:	1263	

TABLE II

DISTRIBUTION OF MEMORY SPAN FOR THREE-LETTER WORDS

Measure	No. of Cases	Percentage
3	16	1.3
4	82	7.1
5	372	32.3
6	275	23.9
7	274	23.8
8	131	11.4
Total:	1150	

TABLE III

DISTRIBUTION OF MEMORY SPAN FOR SYLLABLES

Measure	No. of Cases	Percentage
10	3	.33
20	44	4.8
25	104	11.4
30	584	64.5
35	140	15.4
40	21	2.3
45	—	—
50	9	.9
Total:	905	

TABLE IV

DISTRIBUTION OF MEMORY SPAN FOR IDEAS

Measure	No. of Cases	Percentage
0	12	1.4
1	49	6.02
2	97	11.09
3	85	10.4
4	122	15.02
5	118	14.5
6	118	14.5
7	87	10.7
8	60	7.4
9	29	3.5
10	23	2.8
11	10	1.2
12	2	.24
Total:	812	

TABLE V

DISTRIBUTIONS OF MEMORY SPAN TESTS FOR DIGITS

Measure	Original Group Test	Repetition Group Test	Individual A-V Test	Individual V-V Test	Group Test (Backward)
13	.....	....	.....	1	.....
12	8	21	1	2	.....
11	16	26	5	7	.....
10	32	37	22	73	6
9	64	60	61	89	37
8	71	47	91	53	69
7	62	29	55	33	48
6	29	16	20	2	48
5	5	1	6	1	9
4	0	0	0	0	3
3	0	0	0	0	0
SIGNIFICANT RESULTS:					
Maximum.....	12	12	12	13	10
Median.....	8	9	8	9	8
Mode.....	8	9	8	9	8
Mean	8.18	8.9	8.07	8.8	7.39
Minimum.....	5	5	5	5	4

TABLE VI

ORIGINAL GROUP TEST FOR MEMORY SPAN FOR DIGITS FORWARD AND REPETITION GROUP TEST COMPARED

Repetition Group Test Scores									
12			1	3	5	3	3	4
11			1	7	9	3	6	0
10			7	9	11	6	2	2
9		6	9	16	17	10	1	2
8	2	6	16	14	7	2	1	
7	2	4	14	6	1	2		
6	0	9	4		2	1		
5	1							
	5	6	7	8	9	10	11	12

THE ORIGINAL GROUP TEST SCORES

TABLE VII

ORIGINAL GROUP TEST FOR MEMORY SPAN FOR DIGITS FORWARD AND INDIVIDUAL VISUAL-VOCAL TEST COMPARED

Individual Visual-Vocal Test Scores								
13					1			
12					1		1	0
11		1	1	1	1	1	2	0
10		2	9	20	18	13	7	4
9		5	23	24	22	12	1	2
8	1	10	16	10	10	3	1	2
7	4	9	7	6	4	1	2	
6	1	1	0					
5	0		1					
	5	6	7	8	9	10	11	12

ORIGINAL GROUP TEST SCORES

Table VIII

Original Group Test for Memory Span for Digits Forward and Individual Vocal-Auditory Test Compared

Individual Vocal-Auditory Test Scores	5	6	7	8	9	10	11	12
12								1
11					3	2	0	0
10			1	1	7	5	6	2
9		1	7	24	21	5	2	1
8		8	22	24	15	13	5	4
7	2	12	21	8	8	3	1	
6	3	3	6	4	2	2		
5	1	4			1			

Original Group Test Scores

Table IX

Original Group Test for Memory Span for Digits Forward and Group Test for Digits Backward Compared

Group Test Backward Scores	5	6	7	8	9	10	11	12
12								0
11							0	0
10				2	2	0	0	1
9		3	2	9	8	6	7	2
8		2	14	15	20	13	4	1
7	3	5	16	13	5	3	2	1
6	1	8	19	10	7	1	1	1
5	1	3	0	3	2			
4	0	2	1					

Original Group Test Scores

TABLE X

COMPARISON OF ORIGINAL GROUP TEST FOR DIGITS

AND

	REPETITION				INDIVIDUAL A-V				INDIVIDUAL V-V				BACKWARD			
	−	+	av.	V	−	+	av.	V	−	+	av.	V	−	+	av.	V
5		2.5	2.	+2.		1.4	1.16	+1.16		2.0	2.0	+2.0		1.7	1.4	+1.4
6		2.1	1.36	+1.36	1.0	1.95	1.6	+1.32		2.0	1.9	+1.9	1.4	1.8	1.09	+.47
7	1.0	2.08	1.44	+1.3	1.0	1.3	.78	+.57	2.0	1.8	1.66	+1.59	1.1	1.12	.76	−.07
8	1.0	1.9	1.32	+1.1	1.33	1.04	.68	+1.6	1.0	1.26	1.19	+1.0	1.61	1.27	1.09	−.55
9	1.5	1.76	1.13	+.55	1.5	1.3	.94	−.49	.64	1.28	.63	+.31	1.73	2.0	1.43	−1.25
10	1.6	1.5	1.22	−.55	2.08	1.0	1.66	−1.5	1.31	1.0	.73	−.66	1.95		1.91	−1.91
11	1.75	1.0	.76	−.30	2.41		2.41	−2.0	1.81	1.0	1.5	−1.25	2.78		2.78	−2.78
12	2.5		1.25	−2.5	3.28		2.87	−2.87	2.75		2.75	−2.75	3.83		3.83	−3.83
Total	1.51	1.97	1.32	+.72	1.82	1.27	1.09	−.16	1.58	1.72	1.32	+.64	1.85	1.37	1.35	−.88

− : Minus Variation.
+ : Plus Variation.

av : Average Variation.
V : Average Difference.

TABLE XI

VARIATION BETWEEN THE INDIVIDUAL TESTS FOR DIGITS VOCAL-AUDITORY AND VISUAL-VOCAL

Average Variation 1.2
Average Gain .76 Visual over Auditory

−3	−2	−1	0	+1	+2	+3	+4
3	11	30	67	85	61	13	7

TABLE XII

LOW MEMORY SPAN

Comparison of Per Cent Referable to:

Defect in:	Digits	Three-Letter Word	Syllables	Ideas
OBSERVATION	56.25	29.72	61.9	48.27
DISTRIBUTION OF ATTENTION	50.	16.21	28.57	41.38
DESCRIPTION	56.25	16.21	33.33	41.38
DIFFERENCE AND LIKENESS	18.75	11.21	33.33	41.38
DEFINITION	18.75	16.21	9.52	31.04
OPPOSITES	37.5	21.62	33.33	41.38
LANGUAGABILITY	31.5	43.24	52.33	37.93
MEMORY	56.25	40.54	42.85	41.38
ARITHMETRIC PROFICIENCY	50.	37.85	33.33	37.93

TABLE XIII

HIGH MEMORY SPAN

Comparison of Per Cent Referable to:

Abilities in:	Digits	Three-Letter Word	Syllables	Ideas
OBSERVATION	75.	78.79	71.72	50.
DISTRIBUTION OF ATTENTION	68.75	69.70	45.46	83.34
DESCRIPTION	81.25	91.	72.73	66.67
DIFFERENCE AND LIKENESS	100.	87.88	90.91	83.34
DEFINITION	68.75	60.61	90.91	83.34
OPPOSITES	100.	90.91	72.73	83.34
LANGUAGABILITY	93.75	81.82	81.82	50.
MEMORY	75.	57.58	81.82	66.67
ARITHMETRIC PROFICIENCY	81.25	78.79	54.55	66.67

TABLE XIV

MEMORY SPAN SCORES REFERABLE TO PSYCHOLOGY GRADES

Memory Span		*Psychology Grades*		
		High.....3.5.....	Low	Ratio
DIGITS	High	64%	36%	2 to 1
	Low	19%	81%	4 to 1
THREE-LETTER WORDS	High	61%	39%	2 to 1
	Low	33%	67%	2 to 1
SYLLABLES	High	53%	47%	1 to 1
	Low	15%	85%	4 to 1
IDEAS	High	62%	38%	2 to 1
	Low	7%	93%	13 to 1

TABLE XV

MEMORY SPAN SCORES REFERABLE TO COLLEGE GRADES

Memory Span		*College Grades*		*Ratio*
		High.....3.5.....	Low	
DIGITS	High	78%	22%	4 to 1
	Low	42%	58%	1 to 1
THREE-LETTER WORDS	High	85%	15%	4 to 1
	Low	56%	44%	1 to 1
SYLLABLES	High	90%	10%	9 to 1
	Low	25%	75%	3 to 1
IDEAS	High	87%	13%	9 to 1
	Low	42%	58%	1 to 1